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DEVELOPMENT OF A WEB BASED CORRUPTION CASE MAPPING USING MACHINE LEARNING WITH ARTIFICIAL NEURAL NETWORK

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Development of a Web Based Corruption Case Mapping Using Machine Learning with Artificial Neural Network (Conference Paper)

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Abstract

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Cumulative state loss over the years caused by corruption in Indonesia has reached a fantastic number of 15 Billion usn up until 2016 [1]. To imagine the severances of it, 10.000 KM of highway can be built with that much amount of fund. Several responses has been done by Indonesian government to fight corruption from both prevention and persecution. This work focuses on the development of a web application aimed to provide insight to corruption case per province in Indonesia. The web application was developed using Machine Learning, specifically Backpropagation Artificial Neural Network (ANN). Web crawling and web scraping techniques are used to gather news content from 7 major news portal in Indonesia. Accuracy is measured by comparing correct prediction by ANN to its true value. Upon finding corruption news, data is saved and further analysis is done to establish the number of corruption news per region. Finally, the output is visualized using Google Map API. The purpose of this work is to provide regional depiction of corruption case to give further insight to be used by decision makers. Upon using this web application, objectivity of program development is expected to increase. The final output of the web application is a map of corruption case in Indonesia per region. The accuracy of ANN used in this work to classify corruption and non-corruption news is 96.91 % using Sigmoid Activation Function. © 2018 IEEE.

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References (19)

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1 Pradiptyo, R., Partohap, T.H., Pramashavira
Korupsi Struktural; Analisis Database Korupsi Versi 4 (2001-2015)
5 April 2016[Accessed September 2016]
http://cegahkorupsi.feb.ugm.ac.id/publikasi-/Database%20Korupsi%20V%204-5April16_RP_VR_THP.pdf

2 Rose-Ackerman, S., Palifka, B.J.
Corruption and government: Causes, consequences, and reform: Second edition
(2016) *Corruption and Government: Causes, Consequences, and Reform: Second Edition*, pp. 1-644. Cited 72 times.
http://www.cambridge.org/de/academic/subjects/economics/public-economics-and-public-policy/corruption-and-government-causes-consequences-and-reform-2nd-edition?
ISBN: 978-113996293-3; 978-110708120-8
doi: 10.1017/CBO9781139962933
View at Publisher

3 Jain, A.K.
Corruption: A review
(2001) *Journal of Economic Surveys*, 15 (1), pp. 71-116. Cited 469 times.
View at Publisher

4 Sommer, U., Bloompazit, P.B.-N., Arikan, G.
Does faith limit immorality? The politics of religion and corruption
(2013) *Democratization*, 20 (2), pp. 287-309. Cited 9 times.
doi: 10.1080/13510347.2011.650914
View at Publisher

5 Madsen, F.G.
Corruption: A global common evil

(2013) *RUSI Journal*, 158 (2), pp. 26-38. Cited 4 times.
doi: 10.1080/03071847.2013.787730

View at Publisher

6 International, T.
Slow, Imperfect Progress Across Asia Pacific, " 21 February 2018
[Accessed 21 May 2018]
https://www.transparency.org/news/feature/slow_imperfect_progress_across_asia_pacific

7 Olken, B.A., Pande, R.
(2011) *Corruption in developing countries Scholars at HARVARD*

8 International, G.
(2018) *Corruption Continues to Plague Indonesia*
[Accessed 21 May 2018]
http://news.gallup.com/poll/157073/corruptioncontinues-plague-indonesia.aspx

9 Henderson, J.V., Kuncoro, A.
Corruption in Indonesia
(2004) *National Bureau of Economic Research*, pp. 1-38.

10 *Indonesia Corruption Watch Survei Nasional Anti Korupsi*
26 July 2017. [Online] [Accessed 21 May 2018]
https://antikorupsi.org/sites/default/files/files/Kajian/Temuan%20Hasil%20Survey%20Anti%20Korupsi%202017.pdf

11 *Annual Report 2016 Indonesia Corruption Watch-Menyemai Semangat Antikorupsi*
Indonesia Corruption Watch June 2017. [Online] [Accessed 21 May 2018]
https://antikorupsi.org/sites/default/files/Laporan%20Akhir%20Tahun%20ICW%202016.pdf

12 Bolongaita, E.P.
(2010) *U4 Issue 4, Utstein*, p. U4.

13 Bertot, J.C., Jaeger, P.T., Grimes, J.M.
Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies

(2010) *Government Information Quarterly*, 27 (3), pp. 264-271. Cited 810 times.
doi: 10.1016/j.giq.2010.03.001

View at Publisher

14 Pratomo, D.A., Kriyantono, R.
The power of media effect: Construction television as media for anti-corruption education in Indonesia
(2016) *KKU International Journal of Humanities and Social Sciences*, 6 (1), pp. 1-9. Cited 2 times.

15 Neupane, A., Soar, J., Vaidya, K.
The potential of e-procurement technology for reducing corruption

(2012) *International Journal of Information Technology and Management*, 11 (4), pp. 273-287. Cited 11 times.
doi: 10.1504/IJITM.2012.049997

View at Publisher

16 Neu, D., Everett, J., Rahaman, A.S.
Preventing corruption within government procurement: Constructing the disciplined and ethical subject

(2015) *Critical Perspectives on Accounting*, 28, pp. 49-61. Cited 21 times.
http://www.elsevier.com/inca/publications/store/6/2/2/8/1/3/index.htt
doi: 10.1016/j.cpa.2014.03.012

View at Publisher

17 International, T.
Technology Against Corruption, " 8 May 2013
[Accessed 22 June 2018]
https://www.transparency.org/news/feature/technology_against_corruption

18 Muqsith, M.A., Sasmoko, A., Wulandhari, N.L., Alamsyah, M.
Corruption cases mapping based on Indonesia's corruption perception index
(2017) *Journal of Physics: Conference Series*, 801 (1), pp. 12-19.

19 Noerlina, Wulandhari, L.A., Arifin, Y., Sasmoko, Ashari, A.M.M., Alamsyah, M., Kelvin, (...), Soenarto, H.
Corruption system development based on Indonesia's corruption perception index

(2018) *ICIC Express Letters, Part B: Applications*, 9 (2), pp. 155-162.
http://www.icicelb.org/ellb/contents.html

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***Abstract*—Cumulative state loss over the years caused by corruption in Indonesia has reached a fantastic number of 15 Billion USD up until 2016 [1]. To imagine the severances of it, 10.000 KM of highway can be built with that much amount of fund. Several responses has been done by Indonesian government to fight corruption from both prevention and persecution. This work focuses on the development of a web application aimed to provide insight to corruption case per province in Indonesia. The web application was developed using Machine Learning, specifically Backpropagation Artificial Neural Network (ANN). Web crawling and web scraping techniques are used to gather news content from 7 major news portal in Indonesia. Accuracy is measured by comparing correct prediction by ANN to its true value. Upon finding corruption news, data is saved and further analysis is done to establish the number of corruption news per region. Finally, the output is visualized using Google Map API. The purpose of this work is to provide regional depiction of corruption case to give further insight to be used by decision makers. Upon using this web application, objectivity of program development is expected to increase. The final output of the web application is a map of corruption case in Indonesia per region. The accuracy of ANN used in this work to classify corruption and non-corruption news is 96.91% using Sigmoid Activation Function.**

Keywords—machine learning, corruption prevention, web application, corruption mapping

I. INTRODUCTION

Interpreting the definition of corruption relies heavily on personal aspects such as time, location, and scientific discipline [2]. A variety of definition from numerous sources can be discovered. Jain [3] characterizes corruption as a behavior when public power is used to attain personal profit while contradicting with the rules. Sommer [4] describes it as a government power misuse by the government officials to get personal benefit they shouldn't have. Madsen [5] argue in deeper yet broader context as a condition where someone is given incentives to do something he/she should not do, or not doing what he/she should do according to law and regulation. From all of the definitions, the most comprehensive, universal, and able to define corruption in the best way is from Transparency International (TI) that defines corruption as an act of misusing bestowed power to obtain private gain, as it liberates the concept corruption constricting solely in government institute, and it takes account not only the juristic restriction but also enables the unwritten rule of moral and ethical value to be included in the definition [6]. This research will elaborate on a development of web application to map corruption. Section 1 will explain the basis and background of identified problems, Section 2 will explain the methodology used in this work, and Section 3 will elaborate the finished application result, along with the percentage of accuracy.

A. Corruption in Indonesia

Even though the case of corruption is more common to be found in developing countries over-developed countries, it is far from correct to distinct it from global issues [7]. Corruption is a risk for international advancement and even mentioned by G8 as a security risk [5]. In Indonesia, 8 out of 10 Indonesian citizen say that corruption has widely spread in the country, with 91% say that it comes from governmental sector and 86% say that it comes from business sector [8]. This citizen perception is supported by report from various public companies claiming to spend over 10% of their time and expenses – that they can use in other productive aspects, in bribing government officials [9]. The report stated that the bribing is crucial for the companies to accelerate their business and administrative errands with local officials. A national survey of anti-corruption conducted by Indonesia Corruption Watch (ICW) explained that public sectors that they perceived as most corrupt are: government employees hiring (56%), police (50%), procurement of goods and services from government offices (48%), and court of law (45%) [10]. The underlying findings here is that Indonesian citizen's perception of corruption is bigger compared to other South East Asia countries. This is regardless of the fact that Indonesia is progressing toward better position in Corruption Perception Index (CPI) in the past 5 years, moving from position 32 to 37 [6].

Media news about of corruption victims are not as many and as palpable as other crimes such as robbery or sexual harassment, but it does not mean that the number of victims are paltry, nor does it means that the consequences are mild. Referring to ICW 2016 annual report, the total of corruption case in Indonesia from the beginning to the end of 2016 reaches 238 cases, with the total of state loss reaching 1 Trillion Rupiah or around 70.000.000 USD in 2016 alone [11]. The number looks more prominent when the perspective is widened to put all previous state loss into account. Up until 2016, the total loss of corruption in Indonesia reached a fantastic number of 209.3 Trillion Rupiah, or close to 15 Billion USD. That amount of money could be used to build 600 Hospitals with international standard, to graduate 546.000 domestic scholars or 45.500 overseas Ph.Ds, to liberate cost of social security (BPJS) for all Indonesian citizens, or to construct over 10.000 km of highway or 202 km of MRT [1]. It is very important to focus on corruption prevention as soon as possible and to fight it as hard as possible because every day passing with improper and inefficient strategy to fight corruption, more and more of state fund is lost.

B. Similar Solution for Corruption

Looking at the tremendous amount of loss caused by corruption, much solution has been thought of by all pillars of government: legislative, executive, and judicative. The solutions range from preventing corruption by improving education about corruption and implementing e-government, to prosecuting perpetrators of corruption by establishing Corruption Eradication Commission (KPK) [12, 13, 14]. Unfortunately, not a lot of solutions are involving technology, specifically Information Technology. Taking into account the vast capability of Information Technology, it is very beneficial to utilize that power to tackle an issue as big as corruption. Some of the previous works used to reduce corruption are shown in the Table I below:

TABLE I. PREVIOUS WORKS IN TECHNOLOGY AIDED CORRUPTION PREVENTION

Technology Aided Corruption Prevention	Description
E-procurement	E-procurement has a lot of benefits, from enhancing accountability, effectiveness and transparency [15, 16]. E-procurement is deemed effective but has some problems in implementation.
Whistleblowing	Whistleblowing applications enable people to report when they find an act depicting corruption or the result of corruption and can be used via web, phone calls, or SMS [17]. The focus of whistleblowing is to assist mostly in prosecution, not in prevention.
Corruption Case Mapping	Previous corruption case mapping has established the concept and algorithm [18], but is lacking in the media of visualization.

C. Aim of work

A vast majority of solutions can be thought of in various field of Information Technology, and machine learning is one of the most popular disciplines in Information Technology. With abundant data that are easily accessible from using the internet, machine learning is a powerful tool to prevent corruption. While machine learning can also assist the process of prosecuting corruption, this work is going to focus on aiding the corruption prevention effort by providing valuable information about the comparison between all provinces in Indonesia.

The application elaborated in this work is expected to assist related stakeholders and decision makers in their corruption prevention actions. It captures news contents from 7 Indonesian news sites, classifies each content as either a piece of news about corruption case or not, and visualizes it in the form of geographical map using Google API. The scope of this work is limited to presenting a finished web application, as previous extensive work was done to specify the detailed algorithm process from text processing, up to content classification [18].

II. METHODOLOGY

The theoretical framework of developed application is represented in Fig. 1. The sequence begins by gathering news articles as the primary data to be processed. The content is gathered by first using web crawling program, continued with

extracting the information using web-scraping program. The scraped contents were preprocessed, to prepare it for classification process using Artificial Neural Network with Backpropagation method. The classified news articles were then counted to act as input for the web application. The detail for data source collection and ANN algorithm as a classifier will be explained further in the following paragraph. Previous research has explored the classification process of corruption case using Naïve Bayes, N-Gram, and Hash Table, but this work was conducted using ANN to exploit the plentiful supply of data [19].

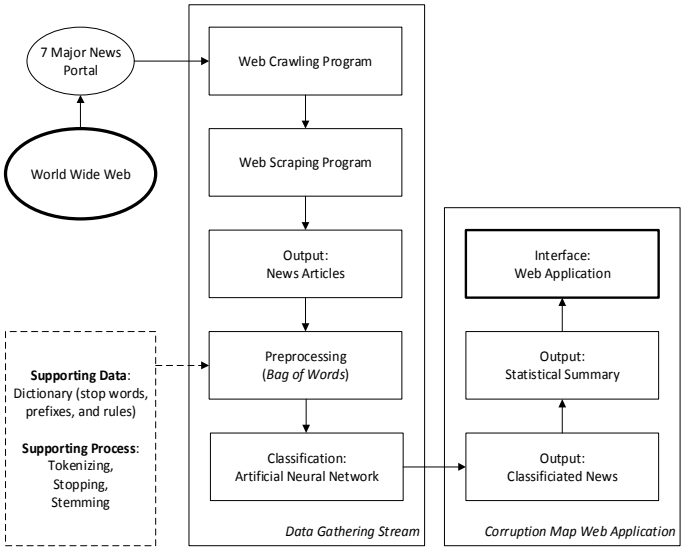

Fig. 1. Theoretical Framework

A. Data source collection

The data used as a source in the web application is obtained using web crawling and web scraping. Crawling is used to crawl from one page to another page, following every link inside the page. A Database will store the crawling result as an index. Next, the stored index will be scraped by gathering and extracting the content, followed by inserting it into the database. This process will be repeated over and over following every index obtained in the crawling phase. To execute the crawling and scraping, we used Cron Scheduling to continuously run crawling and scraping command in a periodic manner. For this work, the process of crawling and scraping is done once per minute. This is considering the internal process of crawling and scraping takes around 20-40 seconds. Over 900.000 news articles are ready to be classified. Up until the process of writing this paper, the server is still actively crawling and scraping news for content. Out of the 900.000 news articles, around 2.000 articles or 0.2% are corruption-related articles. Around 25% of the corruption article pools are used as training data, and 6% are used as testing data.

The news contents are gathered from 7 major news sites in Indonesia: liputan6.com, tribunnews.com, merdeka.com, kompas.com, detik.com, and tempo.co. The underlying reason for selecting the news is based on a few considerations regarding: *(1) the quality of website*, indicated by a good Alexa rank*; (2) the quality of news content*, indicated by a sufficient explanation on 5W and 1H; *(3) accessibility to crawling and scraping*, indicated by having sitemap and allowing robots/crawlers to crawl the web content; and *(4) accessible since at least 2010,* to maintain similarity in the range of content, and to ensure sufficient time periods are available.

TABLE II. CLASSIFICATION WITH ARTIFICIAL NEURAL NETWORK

Component	Detail
Algorithm	: Artificial Neural Network
Method	: Backpropagation
Software Library	: TensorFlow
Act. Function	: Sigmoid
Hidden Layer	: 2 (30,60)
Learning Rate	: 0.1
Epoch	: 1.000
Programming Language	: Python
Batch Size	: 20
Processing Server CPU	: Dual Core
Processing Server RAM	: 8 Gb
Processing Server OS	: UBUNTU 1610
Training Data	: 480
Testing Data	: 120

This work uses Artificial Neural Network (ANN) as preferred algorithm to classify the content along with backpropagation method. The goal of classification is to determine if the each news is talking about corruption, or if it's not. The reason of choosing ANN with backpropagation is because of its ability to adjust its weight gradient connecting each node for every iteration done, resulting in less deviation in output as it keeps training the data.

The input for the ANN will be bag of words, which is a numerical count of occurrence for multi-set words in a document. Each word corresponds to one input node, making a total of over 3000 input nodes for current ANN model. The output of the ANN will be 2 classes: corruption, and non-corruption. Sigmoid Activation Function was used to translate linear input into non-linear output as it shows the highest accuracy compared to Tanh and ReLu.

The data were labeled manually and afterwards the ANN model was trained with 480 random news content. 120 random news content were tested for each respective class to determine the accuracy of the model. The correct prediction was compared to wrong prediction. A single digit percentage will be produced as a quantitative measure to prediction accuracy.

III. Result and Discussions

A. ANN Model & Accuracy

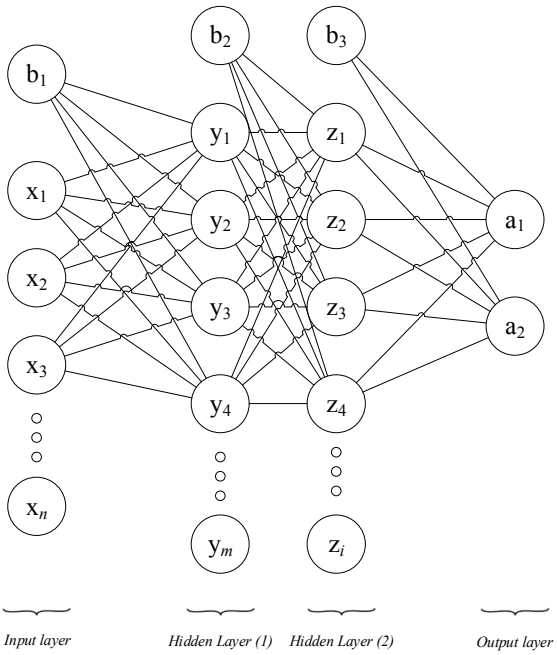

Fig. 2. Corruption Case Prediction ANN Model

Depicted in Fig. 2 is the model for corruption model ANN.

x_n	Input layer nodes n (1, 2, 3.., n)
y_m	First hidden layer nodes m (1, 2, 3.., m)
z_i	Second hidden layer nodes i (1, 2, 3.., i)
b_1, b_2, b_3	Bias Nodes
a_1, a_2	Output layer nodes

After the ANN model has finished training on the 480 training data, 120 test data are used to check the accuracy. The formulation used for accuracy determination is:

$$\frac{Correct\ Prediction}{Total\ Testing\ Data} \times 100\%$$

A total of 3 activation functions were tested while maintaining the consistency of other parameters, and the highest result is obtained from Sigmoid activation function. All three activation functions use 120 testing data. All three used 2 hidden layers, with 30 nodes for the first layer, and 60 nodes for the second layer and 1000 epoch is determined. The overall result is visible in Table III.

TABLE III. Activation Function Accuracy Result and Comparison

Function	Training, Testing	Hidden (1&2)	Epoch	Correct Prediction
TanH	480, 120	30 H1 & 60 H2	1000	90.12%
Sigmoid*	480, 120	30 H1 & 60 H2	1000	90.23%*
ReLu	480, 120	30 H1 & 60 H2	1000	82.80%

* Highest Accuracy

The highest testing process resulted in 90.23% correct prediction. The error rate for the ANN model is determined at 9.77%, with the highest accuracy of prediction is at 90.23% using Sigmoid activation function. Although it must be noted that TanH function does not differ significantly with Sigmoid function, as TanH has 90.12% correct prediction.

B. Web-Based Corruption Case Mapping Development Result Technical Specification

Table IV further detailed the components that are used in the development of the web application.

TABLE IV. Components Used in Web Development

Component	Detail
Framework	: Laravel 5.6
Scripting Language	: PHP
Map Source	: Google Map API
Text Editor	: IntelliJ Idea
Web Server CPU	: Dual Core
Web Server RAM	: 8 Gb
Web Server OS	: UBUNTU 1610

The web application was developed using Laravel framework based on PHP scripting language. Google map API was used for the visual representation of the map. Sublime is used as the text editor, and no IDE is used since web server conducts the process of compiling and debugging. HTML, CSS, and JS are also used as a standard markup language to develop client side of the web application. The main features for this web application are listed in Table V.

TABLE V. Feature List

Feature	Detail
Quantity of Case per Region	The web application is able to show the quantity of detected corruption case news per region as small as per district, up to per province.
Color Hierarchy	To enable a quick visual overview, the map is able to differentiate severity of case with color, from blue to indicate a low case quantity, up to a bright pink to indicate a severe case quantity.
Historical Chart	To visualize increase or decrease in the number of case per province, a historical chart is available, and it shows the monthly or annual change in line chart.

Interactive Map	Since Google Map is used, users are able to zoom in and zoom out on the map, and use dragging function to change the part of the map.

C. Graphical User Interface (GUI)

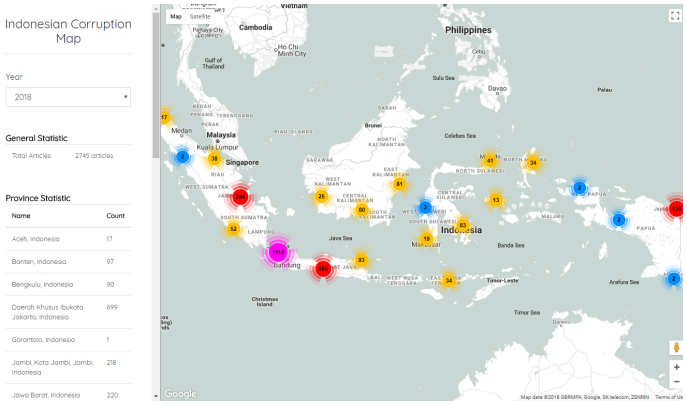

Fig. 3. GUI for Corruption Mapping Web Application – Map View

Upon entering the web application, users will see a map with several colors and numbers as depicted in Fig. 3. Differences of color indicate the status of corruption analyzed based on reported news as represented in Fig. 3. Shown in Table VI is the color hierarchy mapping for the severity of corruption in each district/province.

TABLE VI. COLOR HIERARCHY FOR CORRUPTION MAPPING VALUE

Color	Severity
None / Transparent	: No News
Blue	: Low
Yellow	: Mild
Red	: High
Purple	: Very High

The numbers are clustered based on closest district/province. To see detailed value, users can scroll to zoom into the map, which will result in a redistribution of value to show more detailed regional depiction. Currently, the web application is able to show a detailed location pinpoint up to city or district level.

Fig. 4. GUI for Corruption Mapping Web Application – Monthly Changes & News Per-District

Fig. 5. GUI for Corruption Mapping Web Application – Annual Changes & News Per-District

To further visualize the increases or decreases in one province per period of time, a visual representation in a form of line graph is presented. Users can see both the monthly increase/decrease in corruption news from the graph depicted in Fig. 4 and Fig. 5. Users can also compare monthly change to annual change. This is done to provide further support in decision-making, and to make it easier to compare and to measure a governmental program by seeing whether the graph goes down or up, which can be interpreted as having positive or negative change respectively.

IV. CONCLUSION

Taking on a severe problem as big as corruption is not easy, and should be supported by technology. A web application used to map corruption based on the quantity of news coverage in respective area is created. The web application is able to show visual map of corruption cases in Indonesia. The region can be seen as high as per province, or as detail as per city and district. The web application was developed using a combination of machine learning using Artificial Neural Network (ANN) to

process the classification of corruption news and web technology to act as visualization medium. The highest accuracy of the ANN model is 96.91% using Sigmoid activation function. The purpose of this application is to represent corruption index per region in Indonesia with hopefully will enable a more objective decision making and a more effective program to reduce corruption case.

LIMITATION OF STUDY & FUTURE WORKS

This research is limited in the algorithm used. We did not compare several algorithms, but rather we compared three activation function algorithms. The testing process was also done using simple correct prediction compared to total prediction, because in deep learning researches, other testing method will need a high computing power, for example validation method such as k-fold validation. The next research should tackle the limitation that we faced, to provide more objective outcome. A comparison of more known algorithms is a big suggestion for future research.

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REFERENCES

[1] R. Pradiptyo, T. H. Partohap and Pramashavira, "Korupsi Struktural; Analisis Database Korupsi Versi 4 (2001-2015)," 5 April 2016. [Online]. Available: http://cegahkorupsi.feb.ugm.ac.id/publikasi-/Database%20Korupsi%20V%204-5April16_RP_VR_THP.pdf. [Accessed September 2016].

[2] S. Rose-Ackerman and B. J. Palifka, Corruption and Government: Causes, Consequences, and Reform, 2nd ed., Cambridge: Cambridge University Press, 2016.

[3] A. K. Jain, "Corruption: A review," Journal of Economic Surveys, vol. 15, no. 1, pp. 71-122, 2001.

[4] U. Sommer , P. B.-N. Bloom and G. Arikan, "Does faith limit immorality? The politics of religion and corruption," Democratization, vol. 20, no. 2, pp. 287-309, 2013.

[5] F. G. Madsen, "Corruption: A global common evil," The RUSI Journal, vol. 158, no. 2, pp. 26-38, 2013.

[6] Transparency International, "Slow, Imperfect Progress Across Asia Pacific," 21 February 2018. [Online]. Available: https://www.transparency.org/news/feature/slow_imperfect_progress_across_asia_pacific. [Accessed 21 May 2018].

[7] B. A. Olken and R. Pande, "Corruption in developing countries," Scholars at HARVARD, 2011.

[8] Gallup International, "Corruption Continues to Plague Indonesia," 2018. [Online]. Available: http://news.gallup.com/poll/157073/corruption-continues-plague-indonesia.aspx. [Accessed 21 May 2018].

[9] J. V. Henderson and A. Kuncoro, "Corruption in Indonesia," National Bureau of Economic Research, pp. 1-38, 2004.

[10] Indonesia Corruption Watch, "Survei Nasional Anti Korupsi," 26 July 2017. [Online]. Available: https://antikorupsi.org/sites/default/files/files/Kajian/Temuan%20Hasil%20Survey%20Anti%20Korupsi%202017.pdf. [Accessed 21 May 2018].

[11] Indonesia Corruption Watch, "Annual Report 2016 Indonesia Corruption Watch - Menyemai Semangat Antikorupsi," June 2017. [Online]. Available: https://antikorupsi.org/sites/default/files/Laporan%20Akhir%20Tahun%20ICW%202016.pdf. [Accessed 21 May 2018].

[12] E. P. Bolongaita, U4 Issue, vol. 4, Utstein: U4, 2010.

[13] J. C. Bertot, P. T. Jaeger and J. M. Grimes, "Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies," Government information quarterly, vol. 27, no. 3, pp. 264-271, 2010.

[14] D. A. Pratomo and R. Kriyantono, "The Power of Media Effect: Construction Television as Media for Anti-Corruption Education in Indonesia," KKU International Journal of Humanities and Social Sciences, vol. 6, no. 1, pp. 1-9, 2016.

[15] Neupane, A., Soar, J., & Vaidya, K. "The potential of e-procurement technology for reducing corruption," International Journal of Information Technology and Management, vol 11 no. 4, pp 273-287. 2012.

[16] Neu, D., Everett, J., & Rahaman, A. S. "Preventing corruption within government procurement: Constructing the disciplined and ethical subject," Critical Perspectives on Accounting, vol 28, pp. 49-61.

[17] Transparency International, "Technology Against Corruption," 8 May 2013. [Online]. Available: https://www.transparency.org/news/feature/technology_against_corruption. [Accessed 22 June 2018].

[18] Noerlina, L. A. Wulandhari, Sasmoko, A. M. Muqsith and M. Alamsyah, "Corruption Cases Mapping Based on Indonesia's Corruption Perception Index," Journal of Physics: Conference Series, vol. 801, no. 1, pp. 12-19, 2017.

[19] Noerlina, L. A. Wulandhari, Y. Arifin, S. M. A. Andi and M. Alamsyah, "Corruption system development based on Indonesia's corruption perception index," ICIC Express Letters, Part B: Applications, vol. 9, no. 2, pp. 155-162, 2018.